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NAVAL-STORES YIELDS FROM BARK-BARS

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This paper releases data gathered in current investigations at the Southern Forest Experiment Station, and is subject to correction or modification following further investigation.

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Bark-bars, the vertical strips of unchipped wood between two turpentined faces, are of great interest to naval-stores men. They are frequently referred to as life-bars because of their influence on the gum-yielding capacity of faces, and because of the marked effect they have on the rate of face healing and general vigor of the tree. This portion of the tree usually increases in rate of growth after turpentining begins. If a bark-bar is severed, the expanse of uninterrupted, chipped surface approximately doubles; this usually results in the face becoming partially unproductive owing to the development of "dry face."

Bark-bars 15 inches or more in width (if indeed they can be called bark-bars when this wide) are required to support an 8- or 9-inch face, the size usually considered workable in commercial practice. The bark-bars on the ordinary back-faced tree will attain this width only after a long resting period, in spite of a possible increase in growth rate, because of the smallness of the tree at the start of turpentining. The fact that the trees are small is evidenced by the large number of second-growth trees under sawlog size which, from the standpoint of naval-stores production, are now classed as worked-out trees. Whether the wider of the bark-bars--for instance, those 8 to 10 inches wide--can be worked profitably for naval stores is a question frequently asked.

The financial possibilities of working bark-bars, of course, depend largely upon the gum yield. With information as to yield, an operator can determine, for his own particular operation, the minimum width of bark-bar that is likely to be profitable. To fill this need a study was undertaken in 1935 by the Southern Forest Experiment Station, and the results of work during 2 years are reported in this paper.

The experimental area, comprising about 40 acres in the Osceola National Forest, near Olustee, Fla., located well within the active naval-stores belt, is representative of many worked-out, abandoned naval-stores areas. Prior to purchase by the Government, frequent fires and heavy chipping had resulted in an open and irregularly spaced stand. Most of the trees were old-growth longleaf pines 65 to 100 years old. A few old-growth slash pines in addition to scattered second-growth longleaf and slash pines made up the remainder of the stand. The age of the second-growth averaged about 40 years. The slash pines included a higher proportion of second-growth trees than did the longleaf.

A total of 360 trees ranging from 6.5 to 14 inches in diameter at 10 feet above the ground was originally selected, numbered, and measured, but a severe wind and lightning storm reduced this to 342 trees during the first season of chipping. During the second season this total was reduced to 340 trees. All of the trees had at least two worked-out faces. Bark-bars ranged from 7 to 28 inches in width, and the faces placed on these bars ranged from 3 to 9 inches in width. On each tree only one bark-bar was worked, usually the largest available. Galvanized cups were hung, and aprons and gutters were inserted in shallow ax cuts. A streak $\frac{1}{2}$-inch high and $\frac{1}{2}$-deep was chipped each week from early April to late October of each year, making 32 streaks for the season. The chipping was closely supervised to insure adherence to the specifications for face widths and streaks. Cups were dipped after every four streaks and the gum from each tree was weighed; scrape was weighed at the end of the season. The solid-line curves in figure 1, for a total of 342 trees as noted above, are based on 281 American-faced trees plus 61 French-faced trees, although the yields of the latter are not discussed in this paper. Similarly in figure 2 the solid-line curves are based on 279 American-faced trees plus the 61 French-faced trees,[1/] making a total of 340.

The analysis of the yield data showed that the most important factors influencing the yield of gum from bark-bars were (1) width of face, (2) diameter of tree, and (3) width of bark-bars at the sides of the working face (subsequently referred to as secondary bark-bars). Other factors that were studied--(1) growth rate of turpentined bark-bar, (2) width of unturpentined bark-bar or bars remaining, and (3) tree vigor, as measured by the proportion of the total height in live crown--exerted only a minor influence on the gum yield and are therefore omitted from further discussion.

Figure 1 shows for the first year of work the net effects on gum yield of the factors (1) face width (1-A), (2) diameter of tree (1-B), and (3) width of secondary bark-bars (1-C). Each curve shows the influence on the yield exerted by the single factor in question with the other two factors held constant. Figure 1-A shows the direct relationship between gum yield and face width; and the average gum yield may be read directly from the curve for any face width from 3 to 9 inches. Figures 1-B and 1-C, however, show the corrections for tree size and width of secondary bark-bars to be applied to the basic readings from figure 1-A. Arranged in this manner, the charts are useful for predicting yields. For example, a $5\frac{1}{2}$-inch face on a tree $10\frac{1}{2}$ inches in diameter at 10 feet above the ground and with secondary bark-bars of 4 inches each would show an estimated yield of:

Face width $5\frac{1}{2}$ inches	= 60 oz.	(fig. 1-A)
Diameter of tree $10\frac{1}{2}$ inches	= +10 oz.	(fig. 1-B)
Secondary bark-bar 4 inches	= + 1 oz.	(fig. 1-C)
Total	71 oz.	

From figure 2 the yields for the second year of work may be determined in a similar manner.

1/ The reason that the solid line is lower than the dotted lines of slash or longleaf in figure 2 is that during the second year the French faces included in the total yielded considerably less than the American faces.

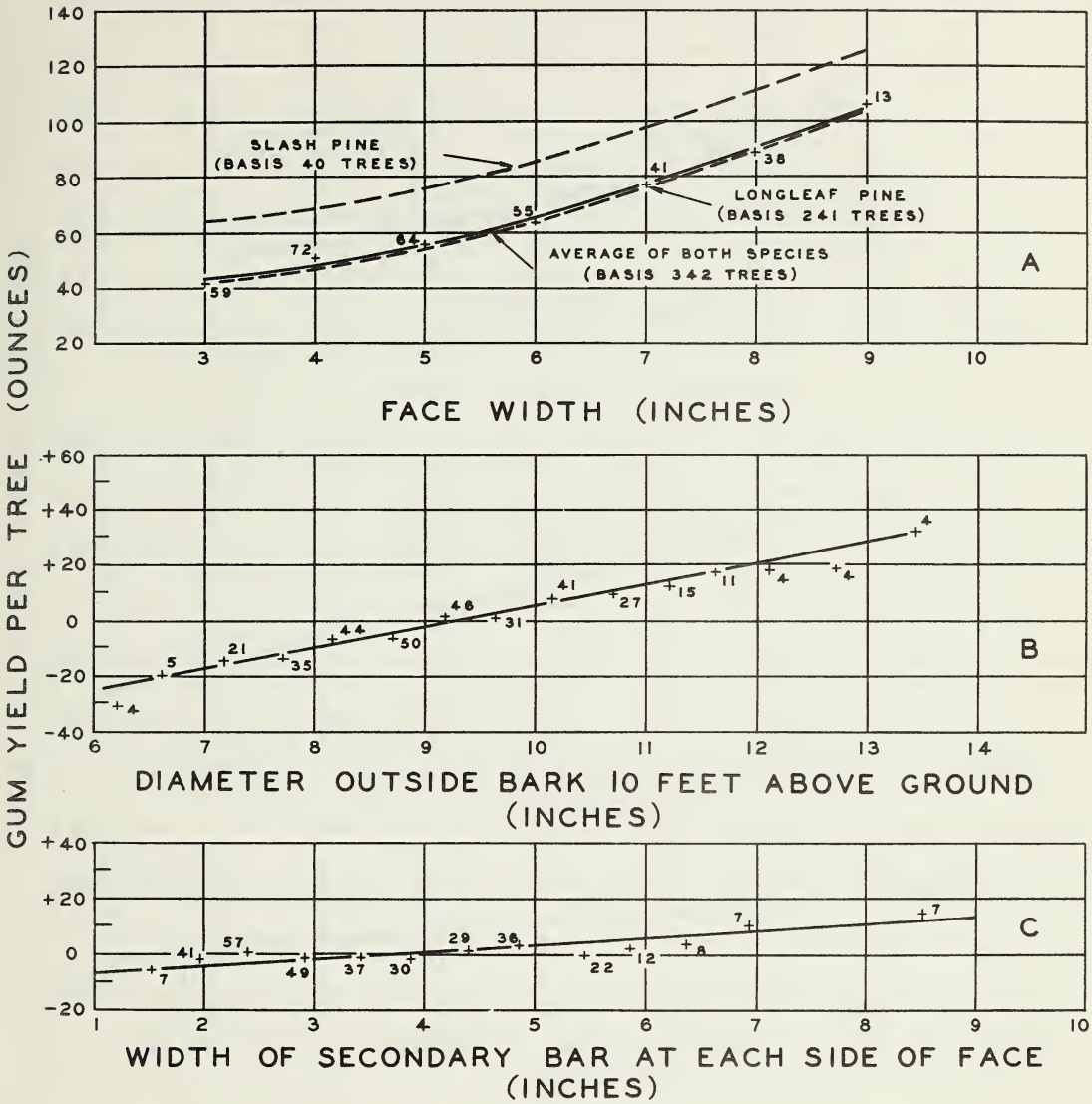

FIGURE 1 : THE RELATION OF FIRST-YEAR GUM YIELD FROM FACES CHIPPED ON BARK BARS TO (A) WIDTH OF FACE, (B) DIAMETER OF TREE, AND (C) WIDTH OF SECONDARY BARK BARS. IN (A) THE YIELD MAY BE READ DIRECTLY, BUT (B) AND (C) SHOW CORRECTIONS TO BE APPLIED TO THE YIELDS INDICATED IN (A) WHEN ALLOWANCE IS MADE FOR DIAMETER OF TREE AND OF WIDTH OF SECONDARY BAR RESPECTIVELY.

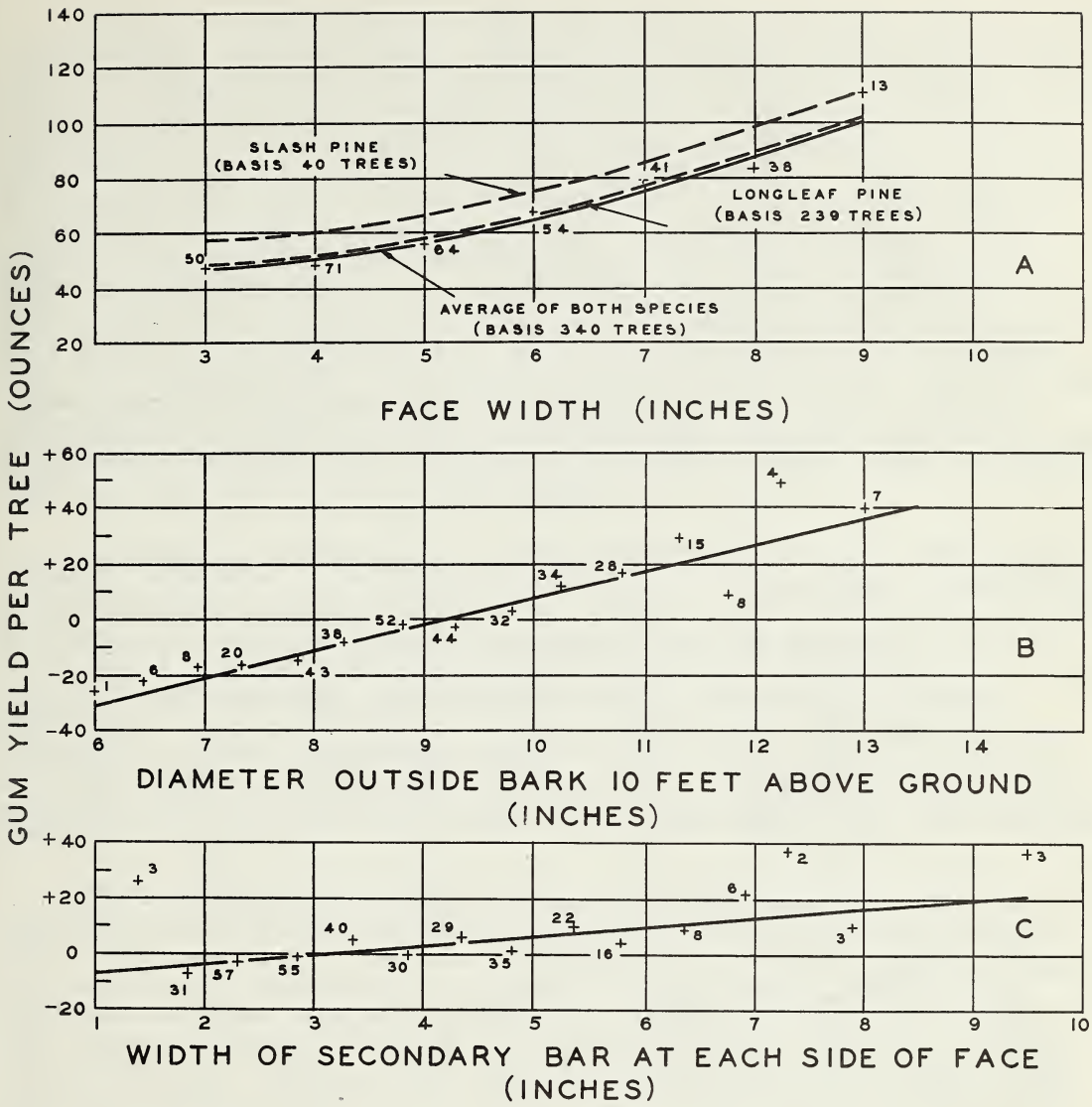

FIGURE 2 : THE RELATION OF SECOND-YEAR GUM YIELD FROM FACES CHIPPED ON BARK BARS TO (A) WIDTH OF FACE, (B) DIAMETER OF TREE, AND (C) WIDTH OF SECONDARY BARK BARS. IN (A) THE YIELD MAY BE READ DIRECTLY, BUT (B) AND (C) SHOW CORRECTIONS TO BE APPLIED TO THE YIELDS INDICATED IN (A) WHEN ALLOWANCE IS MADE FOR DIAMETER OF TREE AND OF WIDTH OF SECONDARY BAR RESPECTIVELY.

It will be noted that gum yield increased rather rapidly with increase in face width. On the average, a 6-inch face yielded about 50 percent more, and a 9-inch face about 140 percent more, than a 3-inch face during the first year, and approximately 40 and 110 percent more, respectively, during the second year. As the diameter at 10 feet above the ground increased within the limits of 7 to 14 inches, gum yield likewise showed a marked increase. As secondary bark-bars increased in size from 1.5 inches to approximately 8.5 inches, the yield increased gradually. The maximum yield for a face of given size was obtained with the maximum bark-bar width available, which permitted a secondary bark-bar of approximately 8 inches at each side of the face. The spread in yield associated with the single factor, secondary bark-bar, proved to be approximately 20 ounces for the range of $1\frac{1}{2}$ to 8 inches. Four-inch secondary bark-bars produced about 6 ounces more gum per face than 2-inch secondary bark-bars, all other conditions being equal. There was approximately a 3-ounce increase in gum yield for each inch increase in width of secondary bark-bar; this increase would amount to about 1 unit of turpentine and rosin for a crop of 10,000 faces.

Although it was possible, by exercising extreme care, to maintain the secondary bark-bars at the widths specified in the experiment, it would not be expected that secondary bark-bars as narrow as 1 inch could be maintained in commercial practice, because the danger of cutting through the life-bar is too great. It does not seem advisable under any circumstances to attempt secondary bark-bars less than 2 inches wide at either side of the face. Neither does it seem advisable to leave secondary bark-bars wider than is necessary to insure a continuous vertical strip of live wood, for to do so is at the expense of either more or wider faces. For general practice, observations have indicated that 4-inch bars at the sides of the face are preferable.

While the solid-line curves in figures 1 and 2 represent slash and longleaf pines combined, the first-year gum yields of slash pine averaged about 35 percent higher than those of longleaf pine (using longleaf yields as a basis for the comparison). During the second season, however, the difference in favor of slash pine was only about 15 percent. The broken-line curves in figures 1-A and 2-A show graphically the difference between the two species. They show also that the average yield from longleaf pine increased slightly during the second season, whereas that of slash pine decreased considerably.

An incidental, though important, fact brought out by the analysis of the second-year yields is that the narrow faces--that is, those 3 to 6 inches in width--produced higher yields during the second year of working than during the first, whereas faces wider than 6 inches produced lower yields.

Gum yields in ounces per tree were read from figures 1 and 2 for slash and longleaf pines separately. These yields were then converted to barrels of turpentine per crop (10,000 faces) and the results are given in tables 1 and 2. Since the figures are based on data collected entirely during the first 2 years, they are strictly applicable only to 2 years of operation. It is believed, however, that for all but the poorest trees the indicated yields should apply for the usual turpentining period, making about the same

Table 1. - Average first-year yields of turpentine[1/] per crop (10,000 faces) from faces of different widths chipped on bark-bars--classified by species, diameter of tree, and width of secondary bark-bars

Width of face	Longleaf pine				Slash pine			
	Tree diameter at 10 feet above ground (inches)							
	8	10	12	14	8	10	12	14
Inches	Barrels of turpentine per crop (first year, 32 streaks)							
	Secondary bark-bars 1 inch wide at each side of face							
3	8	13	18	22	15	20	25	29
5	12	17	22	26	19	24	28	33
7	19	24	29	33	26	31	36	40
9	28	33	37	42	35	40	44	49
	Secondary bark-bars 2 inches wide at each side of face							
3	9	14	19	23	16	21	26	30
5	13	18	22	27	20	25	29	34
7	20	25	29	34	27	32	36	41
9	28	33	38	43	36	41	45	50
	Secondary bark-bars 4 inches wide at each side of face							
3	11	16	20	25	18	23	27	32
5	14	19	24	29	21	26	31	36
7	22	26	31	36	28	33	38	43
9	30	35	40	44	37	42	47	51
	Secondary bark-bars 6 inches wide at each side of face							
3	12	17	22	26	19	24	29	33
5	16	21	26	30	23	28	32	37
7	23	28	32	37	30	35	39	44
9	32	36	41	46	39	44	48	53
	Secondary bark-bars 8 inches wide at each side of face							
3	14	19	23	28	21	26	30	35
5	18	22	27	32	24	29	34	39
7	25	30	34	39	32	36	41	46
9	33	38	43	47	40	45	50	54

1/ Converting factors used to change weight of gum to barrels of turpentine are as follows: turpentine is 20 percent of total weight of clean gum (8 percent of the gum weight is water and trash); 7.245 pounds of turpentine equal 1 gallon; 50 gallons equal 1 barrel.

Table 2. - Average second-year yields of turpentine[1/] per crop (10,000 faces) from faces of different widths chipped on bark-bars--classified by species, diameter of tree, and width of secondary bark-bars

Width of face	Longleaf pine				Slash pine			
	Tree diameter at 10 feet above ground (inches)							
	8	10	12	14	8	10	12	14
Inches	Barrels of turpentine per crop (second year, 32 streaks)							
	Secondary bark-bars 1 inch wide at each side of face							
3	10	16	22	28	13	19	25	31
5	13	19	25	31	16	22	28	34
7	19	25	31	37	22	28	34	40
9	27	33	39	45	30	36	42	48
	Secondary bark-bars 2 inches wide at each side of face							
3	11	17	23	29	14	20	26	32
5	14	20	26	32	17	23	29	35
7	20	26	32	38	23	29	35	41
9	28	34	40	46	31	37	43	49
	Secondary bark-bars 4 inches wide at each side of face							
3	13	19	25	31	16	22	28	34
5	16	22	28	34	19	25	31	37
7	22	28	34	40	25	31	37	43
9	30	36	42	48	33	39	45	51
	Secondary bark-bars 6 inches wide at each side of face							
3	15	21	27	33	18	24	30	36
5	18	24	30	36	21	27	33	39
7	24	30	36	42	27	33	39	45
9	32	38	44	50	35	41	47	53
	Secondary bark-bars 8 inches wide at each side of face							
3	17	23	29	35	20	26	32	38
5	20	26	32	38	23	29	35	41
7	26	32	38	44	29	35	41	47
9	34	40	46	52	37	43	49	55

1/ Converting factors same as in footnote 1, table 1.

allowances for decreasing yield, as turpentining continues, which would be made for ordinary front- or back-facing.

Suppose 36 barrels of turpentine per crop were the minimum which could be accepted as profitable production, and that a 4-inch secondary bark-bar was required. Table 1 shows that, for longleaf, a tree 14 inches in diameter at 10 feet above the ground, with an unturpentined bar of 15 inches to support a 7-inch face, would be needed; for slash, a similar-sized tree having a 13-inch bar for a 5-inch face. For trees of smaller diameter--for example, 10 inches--the requirement would be an unturpentined bar capable of supporting a 9-inch face on longleaf pine or an 8-inch face on slash pine.

The results obtained in this study would seem to indicate rather clearly that for the average operator there is little chance at present of further utilizing profitably the narrow bark-bars (under, e.g., 12 inches) of so-called worked-out trees for turpentining. Even though there may be a slight saving in favor of chipping narrow bark-bars, by using cupping material already on location, for which there are no transportation costs, it cannot be overlooked that under the customary system of naval-stores operation all labor costs constitute only about one-fourth to one-third of the cost of production, and that cup distribution represents only about 2 percent of this. Essentially there seems to be little difference between the gum yield of a bark-bar face and that of an ordinary face, although the possibility of making wider secondary bark-bars on the ordinary face may permit a slight increase in gum yields. It is largely a matter of width of face. As shown in figures 1-A and 2-A, the gum yield increases rapidly as the face width increases from 5 to 9 inches, the widest face used in the experiment.

Summary

An experiment was conducted during 1935 and 1936 on the Osceola National Forest near Olustee, Fla., to determine the gum yields from various widths of faces on bark-bars of different widths. Face widths ranged from 3 to 9 inches and bark-bar widths from 7 to 28 inches.

Analysis showed that the most important factors influencing gum yield were, in increasing order of their importance: (1) width of face, (2) diameter of tree, and (3) width of secondary bark-bars--the live-wood bars at the sides of the new faces. Charts and tables are presented which show the effect of these factors upon gum yield.

Yields from slash pine averaged about 35 percent higher than those from longleaf pine during the first year and approximately 15 percent higher during the second year.

The gum yield from a face on a bark-bar is somewhat less than that from a normal face of similar width because of the wider secondary bark-bars possible on the latter.